Hunting Behavior and Energetics of Weddell Seals

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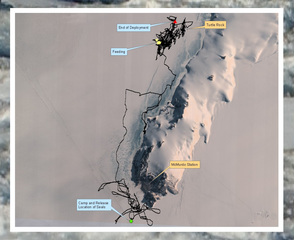
Our projects make use of a specially designed video/data logger to collect data from Weddell seals while they hunt in McMurdo Sound. Sensors record:

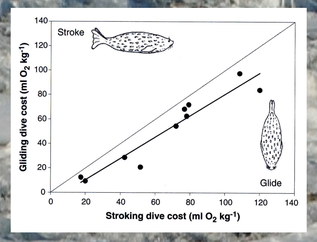
- **speed**
- **depth**
- **acceleration (3 axes)**
- **Earth's magnetic field (3 axes)**
- **GPS locations**

and other environmental variables.

With these data, we can observe the area in front of the seal's head and reconstruct its movements in 3 dimensions for each second of its foraging dives.



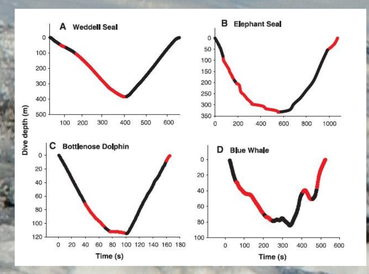
Movements

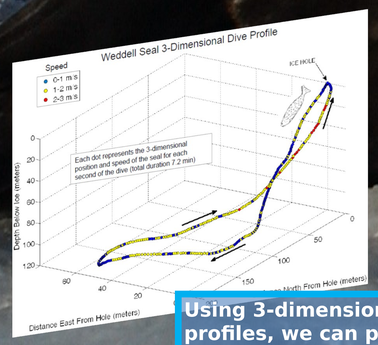


Energetics

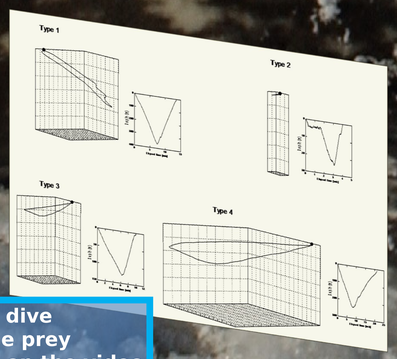
Foraging Behavior

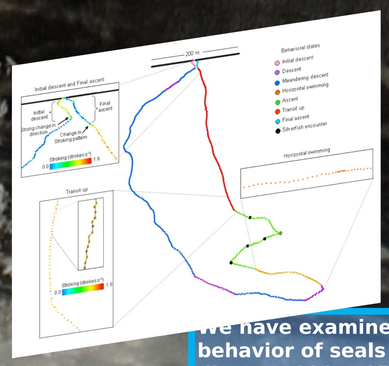
By recording hind flipper stroking, we have discovered that Weddell seals become negatively buoyant at a depth of around 50 m and glide during the remainder of the descent. By using cost-efficient modes of locomotion such as gliding (red lines on graphs to rights) and stroke-and-glide, the seals are able to conserve oxygen and prolong dive duration. When combined with data on fish captures, we find that these efficient swimming behaviors also enable the seals to increase foraging efficiency. In other words, the calories that the seal gains in eating fish far exceed the calories it expends in chasing and catching its underwater prey.



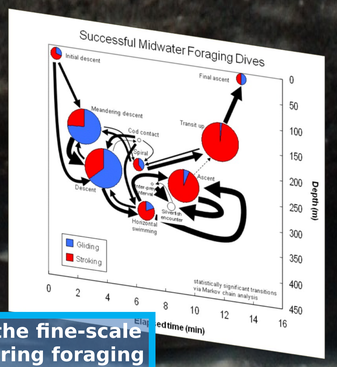

Weddell Seal 3-Dimensional Dive Profile
Speed
0-1 m/s
1-2 m/s
2-3 m/s
ICE HOLE
Each dot represents the 3-dimensional position and speed of the seal for each second of the dive (total duration = 2 min)
Depth Below Ice (meters)
Distance East From Hole (meters)
North From Hole (meters)

Using 3-dimensional dive profiles, we can place prey capture events seen on the video in a larger spatial context. We are have been able to develop a better understanding of the types of dives Weddell seals perform. For example, when diving at an isolated hole, they use four different types of dives (upper right). Almost 100% of dives in which seals caught fish were Type 1 dives. This allows us to identify foraging dives that were unsuccessful.





We have examined the fine-scale behavior of seals during foraging dives and identified a set of stereotypical behavioral patterns. Based on hundreds of observations of seals capturing their primary prey, Antarctic silverfish (*Pleuragramma antarcticum*), we constructed an ethogram that summarizes the hunting tactics they use to capture prey.



FOR MORE INFORMATION SEE OUR PUBLICATIONS:

Davis, R.W., L.A. Fuiman, T.M. Williams, S.O. Collier, W.P. Hagey, S.B. Kanatous, S. Kohin, and M. Horning. 1999. Hunting behavior of a marine mammal beneath the Antarctic fast-ice. *Science* 283:993-996.

Williams, T.M., R.W. Davis, L.A. Fuiman, J. Francis, B.J. LeBoeuf, M. Horning, J. Calambokidis, and D.A. Croll. 2000. Sink or swim: Strategies for cost-efficient diving by marine mammals. *Science* 288:133-136.

Williams, T.M., J. Haun, R.W. Davis, L.A. Fuiman, and S. Kohin. 2001. A killer appetite: Metabolic consequences of carnivory in marine mammals. *Comparative Biochemistry and Physiology A* 129:785-796.

Davis, R.A., L.A. Fuiman, T.M. Williams, and B.J. Le Beouf. 2001. Three-dimensional movements and swimming activity of a northern elephant seal. *Comparative Biochemistry and Physiology A* 129:759-770.

Fuiman, L. A., R. W. Davis, and T. M. Williams. 2002. Behavior of midwater fishes under the Antarctic ice: Observations by a predator. *Marine Biology* 140:815-822.

Davis, R.W., L.A. Fuiman, T.M. Williams, M. Horning, and W. Hagey. 2003. Classification of Weddell seal dives based on three-dimensional movements and video recorded observations. *Marine Ecology Progress Series* 264:109-122.

Williams, T.M., L.A. Fuiman, M. Horning, and R.W. Davis. 2004. The cost of foraging by a marine predator, the Weddell seal (*Leptonychotes weddellii*): Pricing by the stroke. *Journal of Experimental Biology* 207:973-982.

Fuiman, L.A., K.M. Madden, T.M. Williams, and R.W. Davis. 2007. Structure of foraging dives by Weddell seals at an offshore isolated hole in the Antarctic fast-ice environment. *Deep-Sea Research II* 54:270-289.

Madden, K.M., L.A. Fuiman, T.M. Williams, and R.W. Davis. 2008. Identification of foraging dives in free-ranging Weddell seals (*Leptonychotes weddellii*): Confirmation using video records.

Hunting Behavior and Energetics of [redacted]als

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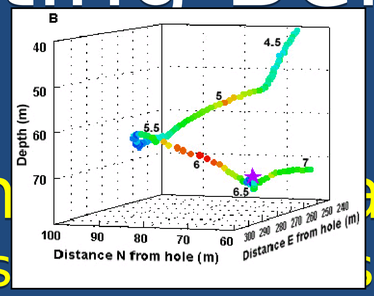
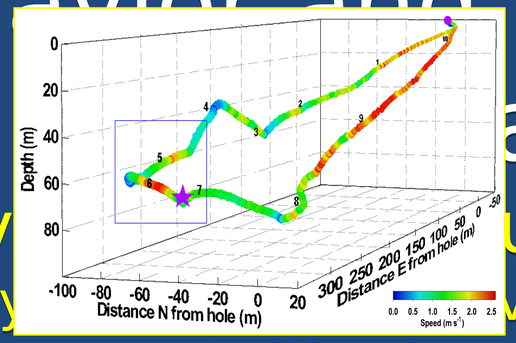
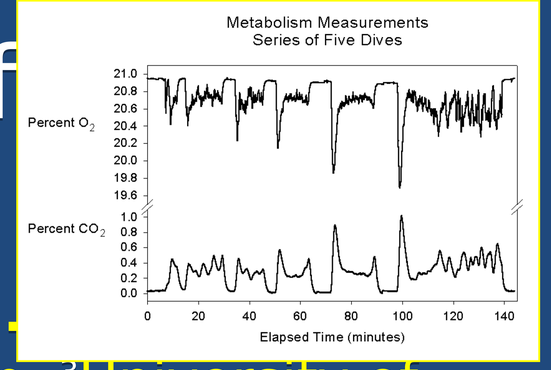
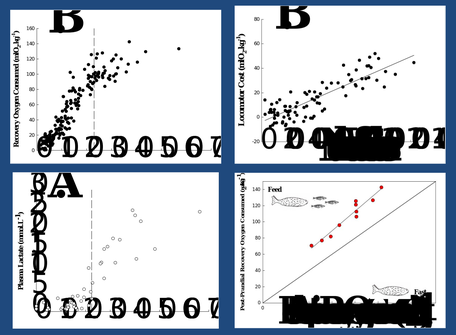
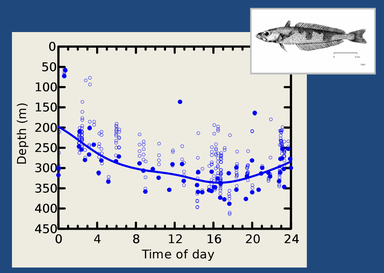
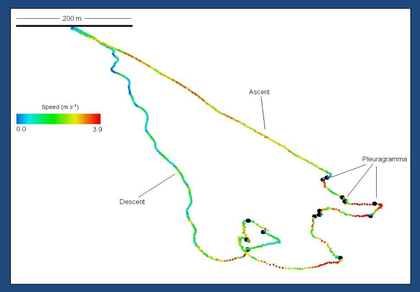


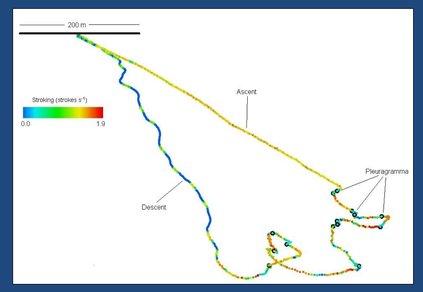


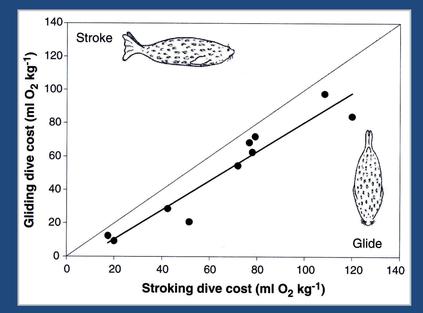


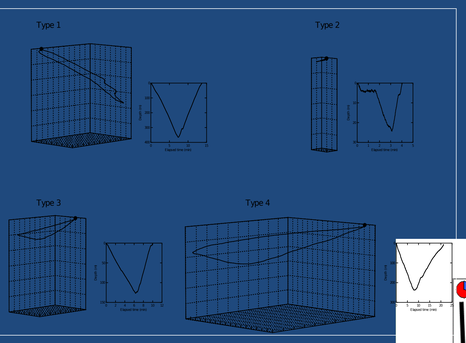


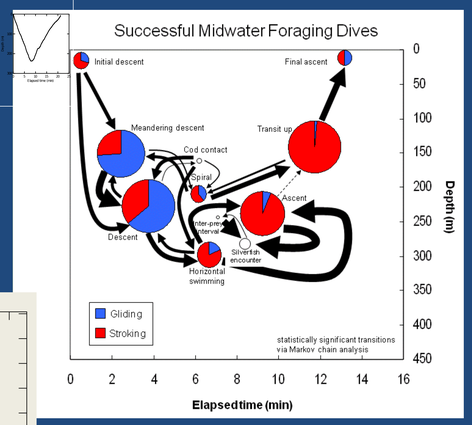


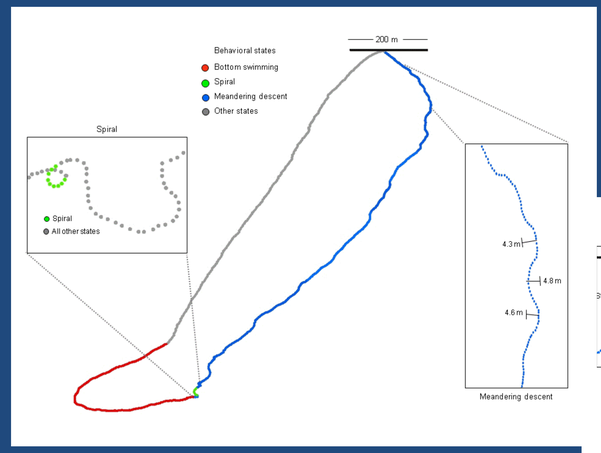


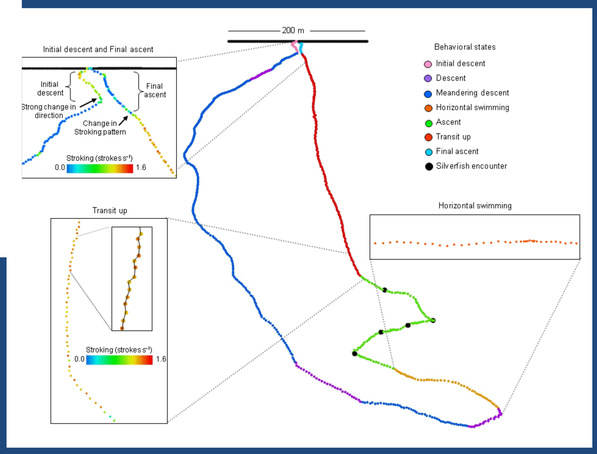


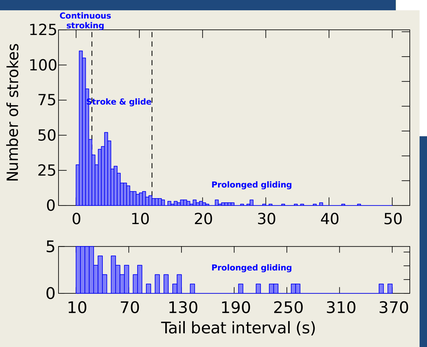


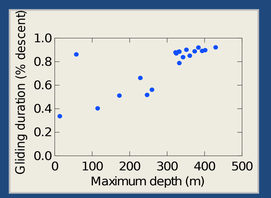


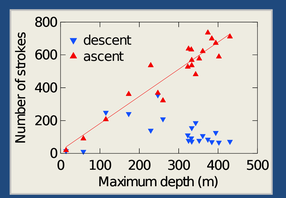


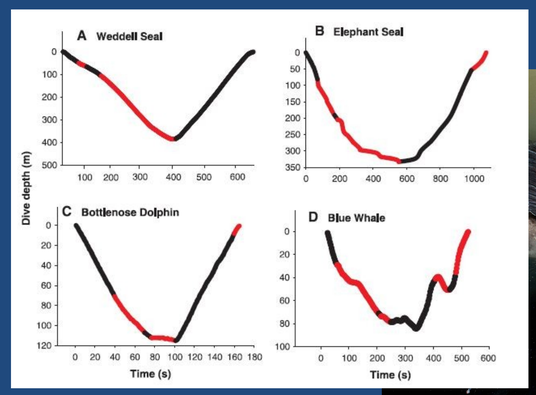


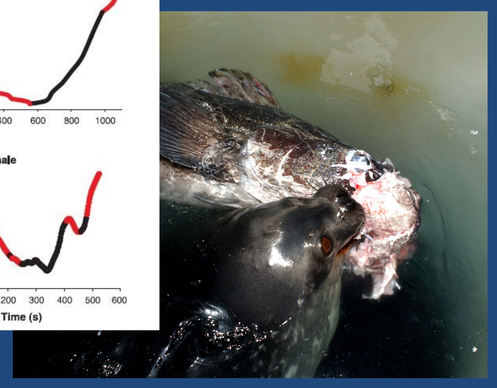


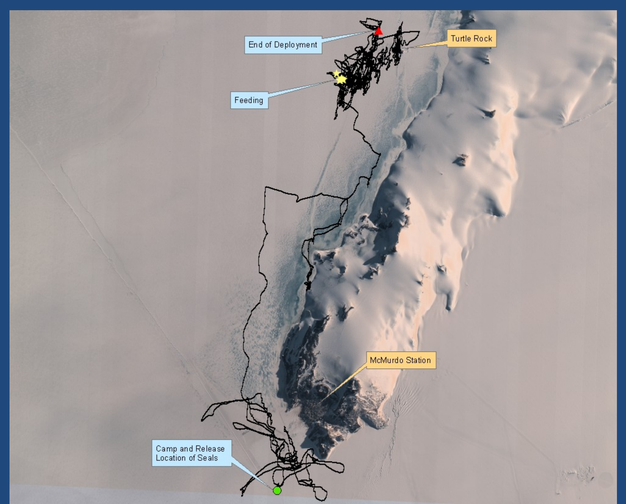







A Weddell Seal
B Elephant Seal
C Bottlenose Dolphin
D Blue Whale
Dive depth (m)
Time (s)




End of Deployment
Tuttle Rock
Feeding
McMurdo Station
Camp and Release Location of Seals